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ABSTRACT

Directed reading activities found in commercially produced instructional materials usually contain information that is aimed at helping children understand the story as well as helping them to develop other skills. To test the effectiveness of both establishing background knowledge and directing children toward central story content, two commercial directed reading lessons were revised to introduce pertinent information and help children form a "map" of the central story content. Twenty-four third grade children read the story as part of an original commercial lesson, and 24 read it as part of a revised lesson. After each lesson, the children recalled the story and answered 35 questions about explicit and implicit story content. Results indicated that (1) the revised version of the lesson exerted a greater influence on comprehension than did the original commercial lesson, (2) the points at which the revised lesson made direct contact with the story exerted a greater influence on comprehension than did points at which only indirect contact was made, and (3) in the revised lesson, the questions following each segment of the story and the preparation before the story exerted greater influence on comprehension then did other lesson components. (Copies of materials used in the study are appended.) (FL)

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LEARNING RESEARCH AND DEVELOPMENT CENTER

THE EFFECTS OF READING LESSONS ON COMPREHENSION: A PROCESSING DESCRIPTION

1984/25

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The Effects of Reading Lessons on Comprehension: A Processing Description

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Directed reading lessons found in commercially produced instructional materials usually contain information that is aimed at helping children understand the story as well as helping them to develop other skills. A commercial directed reading lesson was revised to introduce information related to the story and to help the children form a "map" of the central story content. A processing description of the way in which the components of the commercial and the revised lessons influenced comprehension was provided. Models assuming that different aspects of the lessons were utilized during comprehension were fit to the children's recall of the lesson story. It was found that: (1) the revised lesson exerted a greater influence on comprehension than did the commercial lesson; (2) the points at which the revised lesson made direct contact with the story exerted a greater influence on comprehension than did the points at which only indirect contact was made; and (3) in the revised lesson, the questions following each segment of the story and the preparation before the story exerted greater influence on comprehension than did other lesson components. Implications for instruction and future modeling work are discussed.

INTRODUCTION

Every morning in many primary grade classrooms, the following scenario takes place. A teacher calls together a small group of children, has them sit in a "circle," and begins the daily reading lesson. Following the suggested format in the teacher's manual that accompanies the reading series in use, the teacher prepares the children for that day's reading selection. First, the

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children are introduced to vocabulary and concepts that the teacher's manual had identified as important to the story and potentially problematic for the children. A second type of preparation then occurs in which the children are alerted to story events that occur in the first one-to-two page story segment. The segment is typically called a silent reading unit (SRU). Following this first SRU preparation, the children silently read the SRU, which contains pictures. When the children finish reading the SRU, the teacher asks a series of questions about its contents. Then, the teacher prepares the children for the next SRU and the procedure is repeated until the story is finished. The scenario just described, consisting of Story Preparation, SRU Preparation, Pictures, and SRU Questions, makes up what is known in the reading field as a directed reading lesson. The directed reading lesson is a traditional way to teach reading. It is at least as old as the McGuffy readers of the 1820's and is still the major way that reading is taught.

The fact that directed reading lessons are pervasively used does not mean that they uniformly facilitate comprehension. There is wide variation in how effective individual lessons of commercially produced programs are in helping children comprehend reading selections (Beck, McKeown, McCaslin, & Burkes, 1979; Durkin, 1981). In order to make the effectiveness of directed reading lessons uniformly high, Beck, Omanson & McKeown (1982) argued that the lesson should: (1) introduce and establish background knowledge assumed by the text, and (2) help children to construct a "map" of the story which involves giving them a good grasp of the story's central content. This often is not done in commercially produced programs (Beck et al., 1982). The motivation for optimizing success in comprehending individual reading lessons comes from the notion that children are more likely to become proficient at comprehension if they have large numbers of successful encounters with comprehending stories. This is because it is repeated successful encounters with stories that provide the practice necessary to make the processes involved in comprehension efficient.

To test the effectiveness for story comprehension of establishing background knowledge and directing children toward central story content, two commercial directed reading lessons were revised. Third grade children were then individually administered either the revised or the commercial versions of the two lessons. After the children finished each lesson, they recalled the story from memory and answered 35 forced choice questions about explicit and implicit story content. Beck et al. found that the revised lessons resulted in greater story understanding. While the Beck et al. study demonstrated that the above two principles could be used to produce lessons that facilitated comprehension, the study did not provide a theoretical explanation for how the revised lesson produced such facilitation. The purpose of the

present paper is to provide a theoretical basis for the Beck et al. findings by extending the Kintsch and van Dijk (1978) model of text comprehension.

METHOD

Subjects and Design

Recall protocols for one story from the two groups of children in the Beck et al. study were used. One group consisted of 24 third grade children who read the story as part of an original commercial lesson. A second group consisted of 24 third grade children who read the same story as part of the revised lesson. Both groups of children had a mean grade equivalent score of 4.1 (range = 2.5 to 6.7) on the Level I reading subtest of the Wide Range Achievement Test (Jastak & Jastak, 1965).

Materials

Story

The materials for this study consisted of a second grade directed reading lesson from level 7 of the *Reading 720* series (Clymer, 1976) and its revised counterpart. The story upon which this lesson is based, "The Raccoon and Mrs. McGinnis", contains 811 words. Its plot involves a woman who wishes on a star, a raccoon who comes nightly to her doorstep to look for food, and some bandits. The raccoon's masked appearance happens to frighten the bandits into dropping a bag of money. The raccoon picks up the bag and eventually drops it on Mrs. McGinnis' doorstep while looking for food. Finding the money, Mrs. McGinnis attributes it to her wish on a star.

In order to model comprehension, the story was analyzed in terms of the number of propositions it contained (262) and in terms of the number of processing cycles into which each proposition entered according to the Kintsch and van Dijk model and according to our extensions of this model, both of which are described in a later section.

Lessons

The commercial and revised directed reading lessons surrounding the story consisted of a Story Preparation, SRU Preparation, Pictures, and SRU Questions. Both versions of the lesson took approximately 30 minutes to administer. A brief description of each of the lesson components of the revised lesson is presented and contrasted with its commercial counterpart.

Story Preparation. The Story Preparation component was revised in consideration of the knowledge needed to comprehend the story. The major

concepts around which the preparation was built were coincidence, since Mrs.McGinnis' wish comes true through a series of coincidences, and habit, since the raccoon's habitual behavior allows the coincidences to occur.

The revisions contrast with the Story Preparation component provided by the commercial lesson, which focused on a discussion of raccoons as clever, playful animals. It did not include information about raccoons that was judged as most useful for story comprehension, nor did it present the notion of coincidence. A summary of both the revised and commercial Story Preparation components is presented in Appendix A.

SRU Preparation. The revised SRU Preparation component had a two-fold purpose. First, it reoriented the children to the central story content by providing a focus on key upcoming events. Second, it activated knowledge by referring to concepts previously introduced in the Story Preparation. The activities of the SRU Preparation component of the commercial lesson embodied a variety of purposes, and often did not focus on text ideas. The questions and directives of both the revised and commercial SRU Preparation components are presented in Appendix B.

Pictures. The pictures accompanying the story in the revised lesson were drawn to depict central content in a manner consistent with the overall plot of the story. In contrast, the pictures for the commercial lesson were drawn in a fanciful style which contradicted the real-life nature of the plot. The revised pictures had content similar to the commercial pictures, but were realistic in style. It was assumed that this style would be more likely to promote the idea that the story was a plausible one. The only changes in content of the revised pictures involved the elimination of detail that conflicted with story content. A summary of the content of both the revised and commercial pictures is presented in Appendix C.

SRU Questions. The SRU Questions for the revised lesson were developed from the central events and relations to help the children grasp the plot of the story. The SRU questions in the commercial lesson did not seem to be derived from any such systematic procedure. While some of the questions aimed at eliciting important story content, others tapped information that was irrelevant to the story line. The questions in both the revised and commercial SRU Question components are given in Appendix D.

Processing Model

The models we constructed were based upon Kintsch and van Dijk's (1978) model of comprehension. According to the model, the microstructure of a

story consists of a cohesive set of units of meaning called propositions. The Kintsch and van Dijk model assumes that a reader typically breaks down each sentence of a text into four or five propositions. These propositions are then processed in terms of units called cycles. Each cycle involves processing the propositions contained in a single sentence. During the first cycle, the propositions contained in the first sentence are encoded. To represent this encoding, the Kintsch and van Dijk model constructs a coherence graph, a branching structure that hierachically connects the propositions to a lead proposition on the basis of the overlap among the word concepts (arguments) contained in each proposition. The model assumes that because readers are limited in the amount of information they can hold in working memory at any given time, only a small number of the most recent and superordinate propositions are "carried over" or held in memory to be part of the next processing cycle. The new propositions entering the next cycle are then connected to one of the propositions that was carried over. If a new proposition contains the same argument as a previous proposition that was not carried over, that previous proposition is "reinstated" into the current cycle, allowing a cohesive relation to be established between the two propositions. Thus, through carry-overs and reinstatements, the specific cohesive relations that mold the individual propositions into the microstructure are made.

On the basis of these processing assumptions, the Kintsch and van Dijk model predicts that the probability of a proposition being recalled increases exponentially as a function of the number of cycles in which it occurs. The specific relationship is described as $R = 1 - (1 - p)^n$, where R equals the probability of recall, p equals the probability of recall of a proposition that has appeared in a single cycle, and n equals the number of cycles in which the proposition has appeared.

Extending the Processing Model

Our assumptions in extending the Kintsch and van Dijk model to the comprehension of stories in directed reading lessons was that not only the story text itself influences comprehension, but the surrounding material also exerts an influence. That is, in directed reading lessons, Story Preparation, SRU Preparation, Pictures, and SRU Questions each influence comprehension. Thus, in the present study, while the story text per se was identical for both the revised lesson (hereafter, RL) and commercial lesson (hereafter, CL) groups, it was hypothesized that the commercial and revised lesson components mentioned above would differentially influence comprehension of the two groups.

To assess the influence of the lesson components, we identified for each statement, question, and picture of the surrounding lesson components the

text propositions with which the components made contact. Specifically, two types of contact were distinguished: direct and indirect. Direct contact includes contact that: (1) portrays a specific story event through descriptions, questions, or pictures; or (2) introduces or exemplifies a concept important to the story. Indirect contact includes contact that: (1) asks about a child's personal experience with a type of character or story event without using it to make a relation to the story per se; (2) asks about or describes in a global fashion all the actions a character performs in a SRU. Examples of direct contact that portrays a story event include reminding the children that, in a previous SRU, Mrs. McGinnis went to bed, a picture showing the story event of the bandits walking through the woods, and asking the children "Why did the bandits go to Mrs. McGinnis' house?". In the latter question example, direct contact was considered to exist for both the queried event (going to Mrs. McGinnis' house) and the target answer (to steal the cow and pigs). Direct contact that introduces an important concept includes discussing and exemplifying the notion of a habit, which makes contact with story events such as Mrs. McGinnis' habit of setting out bread for the raccoon. Examples of indirect contact that asks about a child's personal experience include asking the children if they have ever seen a raccoon before, without connecting that notion to the story per se. Indirect contact that globally describes all the actions of a character includes telling the child to read to find out what the raccoon did in a segment of text where the raccoon pursued a number of activities.

These two types of contact points were identified for both the revised and commercial lessons. A second judge was then given a list of specific guidelines for when to include or exclude modifying propositions, repetitions , and other potentially confusing types of propositions. This second judge then identified the contact points contained in the first half of each component of the commercial and revised lessons. Interrater reliability (agreements/ agreements + disagreements) between the two sets of contact points was .86. Disagreements were resolved by mutual consent.

The number of propositions with at least one contact point from the revised lesson was 98 and from the control lessons was 110. Of these propositions, 70 made contact with both lessons.[1]

Having identified the contact points between the text and the surrounding lesson material, we next incorporated the contact points into the Kintsch and van Dijk model of comprehension. We assumed that each contact point provides redundancy that increases the probability of recall of the particular proposition involved. Within the framework of the Kintsch and van Dijk model, the effects of this redundancy can be conceptualized in a way

[1] A list of each proposition's contact points in the revised and commercial lessons is available from the authors upon request.

similar to text reinstatements. Specifically, contact made during the Story Preparation, SRU Preparation, and Pictures can be thought to involve retrieving from memory th" component's reference to the text when the story event is read. Similarly, contact made during the SRU Question component can be thought to involve retrieving from memory the text propositions to which the question refers. Thus, as with text reinstatements, each contact point between the lesson and story was assumed to involve retrieving from memory a text proposition.

In order to incorporate these assumptions into the Kintsch and van Dijk model, we added to the value of the cycle variable (n), for each proposition the number of times the lesson made contact with it. For example, if a proposition had appeared in three processing cycles, was depicted in the pictures, and asked about in the SRU questions, its cycle variable (n) would be 5, and the resulting cycle equation would be $R = 1-(1-p)^5$. Since we assumed that the contact points between the lesson and text functioned like text reinstatements, we refer to contact points as "lesson reinstatements." As will be described later, we examined models incorporating direct, indirect, and both direct and indirect lesson reinstatments.

RESULTS

Amount of Recall

The children's recalls were scored as to whether they contained the gist of each proposition. A second judge scored 10% of the recalls (three from the RL group and two from the CL group). Interrater reliability between the two sets of recalls was .91.

The results from the recall data revealed a non-reliable difference between the RL groups' recalls, $M = 34.5$, and the CL group's recall, $M = 27.8$, $t(46) = 1.33$, $p < .15$. However, recall of the 70 propositions that both lessons made contact with (hereafter referred to as common target propositions) was reliably greater for the RL group, $M = 20.5$, than for the CL group, $M = 14.9$, $t(46) = 2.50$, $p < .05$.

In order to describe the differences in the pattern of these two groups' recalls, a method employed by Spilich, Vesonder, Chiesi, & Voss (1979) was used. First, the proportion of children in each group recalling each of the 70 common target propositions was determined. From these data, recall protocols were generated which consisted of the common target propositions recalled by at least 50% of the subjects in each of the two groups. These data are presented in Table 1.

The 50% recall of the common target propositions of both groups indicated that the story involved a lady, bandits, a raccoon, a cow, pigs, and a

TABLE 1
50% Recall Texts of Common Target Propositions by the Revised and Commercial Lesson Groups

Commercial	Revised
There was a lady, a raccoon, some bandits, a cow, some pigs, and a barn in the story. The bandits stole the cow and pigs. Then they threw down their moneybag and ran away. Mrs. McGinnis found the moneybag on her steps.	There was a lady, a raccoon, some bandits, a cow, some pigs, and a barn in the story. Mrs. McGinnis wished for a barn. The raccoon came down from his tree, picked up some bread, swished it in the water, and ate it. Then he heard two bandits coming along. The bandits stole the cow and pigs. Then they threw down their moneybag and ran away. The raccoon dropped the moneybag on Mrs. McGinnis' doorstep. The next day, Mrs. McGinnis found the moneybag.

barn. However, the only *events* in the 50% recall text of the CL group were that the bandits stole the animals, that they threw down their moneybag and ran away, and that Mrs. McGinnis found the moneybag. In contrast, the events in the 50% recall of the common target propositions of the RL group indicated that Mrs. McGinnis made a wish, that the raccoon came down from his tree, took and ate the bread, that he saw the two bandits and later took to the doorstep the moneybag they threw down, and that Mrs. McGinnis found the moneybag the next morning. The 50% recall text of the RL group thus provided a better account of the story than did the 50% recall text of the CL group. It included the major events of all the characters including the raccoon, and better captured the coincidental flavor of the story.

Lesson Effects

Revised Versus Commercial Lesson

The most important differences in the recall data concern the effects of the two lessons on the *pattern* of recall. To study these effects in greater detail, two types of models were fitted to each group's recall data. The first type of model was an extension of the Kintsch and van Dijk model that incorporated both the direct and indirect lesson reinstatements from either the revised or commercial lesson. These models are called Revised-Support and Commercial-Support since they incorporate the supportive lesson material surrounding the text in the form of lesson reinstatements. Specifically, the Revised-Support model incorporated 278 lesson reinstatements distributed over 98 propositions, whereas the Commercial-Support model incor-

porated 152 lesson reinstatements distributed over 110 propositions. The Revised- and Commercial-Support models thus assumed that both the propositional structure of the text and the surrounding lesson material influences comprehension. The second type of model, called No-Support, employed the Kintsch and van Dijk model without including reference to any lesson reinstatements. This model assumed that only the propositional structure of the text, and not the surrounding lesson material, influenced comprehension. The greater the difference between the Support and No-Support models, the greater the influence of the lesson on comprehension.

Validity of Support Models. Comparing the Revised-Support, Commercial-Support and No-Support models assumes that the two Support models provide a reasonable processing description of the joint effect of a particular lesson and text on comprehension. In order to test the validity of this assumption, the Revised- and Commercial-Support models were fit to the recalls of both the RL and CL groups. If the two Support models describe the joint effect of their respective lesson and text on comprehension, each model should fit the recall of the subjects that received the modeled lesson better than the recall of subjects who received the other lesson. Equations for each proposition were generated from the Commercial- and Revised-Support models. An estimate of the p parameter value was derived for each model by the STEPIT procedure (Chandler, 1975) using the proportion of subjects recalling each proposition for estimating purposes. From the estimated p value, an index of fit in terms of recall variance accounted for was calculated.[2] These results are presented in Table 2.

As shown in Table 2, more of the CL group's variance is accounted for with the Commercial-Support model (.390) than with the Revised-Support

[2]The formula used to calculate the recall variance accounted for was:

$$1 - \frac{\Sigma (x_i - P_i)^2}{\Sigma (x_i - \bar{x})^2}$$

where x_i = the proportion of subjects recalling an individual proposition

$\bar{x}$ = the mean proportion of subjects recalling a proposition

P_i = the predicted proportion of subjects recalling an individual proposition

i = the proposition index running from 1 to n propositions

An alternative estimate of fit that could have been used is RMSD (cf. Spilich et al., 1979) calculated as:

$$\sqrt{\frac{\Sigma (x_i - P_i)^2}{n}}$$

When RMSD was used, the same pattern of results for each group was obtained

TABLE 2
Relative Fit of Revised-, Commercial-, and No-Support Models

Group	Model	Index of Fit: Recall Variance Accounted for	Index of Fit: Biserial Correlation Between Predicted and Actual Recall	Index of Fit: Value of *p* Parameter
Revised Support				
	Revised Support	.415	.647	.050
	Commercial Support	.314	.576	.054
	No Support	.226	.506	.063
Commercial Support				
	Revised Support	.361	.637	.036
	Commercial Support	.390	.670	.045
	No Support	.307	.602	.053

model (.361). Similarly, more of the RL group's recall variance is accounted for with the Revised-Support model (.415) than with the Commercial-Support model (.314). These results suggest that both the Revised- and Commercial-Support models provide a reasonable index of that lesson's influence on comprehension.

In order to assess the reliability of the above differences, the recall scores predicted by the two models (Revised- and Commercial-Support models) were correlated with each subject's recall. For each subject, each proposition was assigned a 1 or 0 indicating whether or not that proposition had been recalled. Using a biserial correlation, this set of 1 and 0 scores was then correlated with the predicted recall of each proposition. In this way an estimate of how well the two models fit each individual subject could be determined.[3] These results are summarized in Table 2. An *r* to *z* transformation was performed on the correlation scores to approximate a normal distribution. An analysis of variance with lesson (revised and commercial) as a between subject factor and model appropriateness as a within subject factor was performed on the *z* transformed correlation scores. The results indica-

ted that for both lesson groups, the appropriate model provided a better fit than did the inappropriate model, $F(1,41) = 13.66$, $p < .01$. No other effects or interactions were reliable.

Relative Effect of Revised- and Commercial-Support. Having established that the two Support models provide a reasonable processing description of the joint effect of the lesson and text, the magnitude of the influence of the lesson over and above the influence of the text was computed by means of influence scores. These scores consist of the difference in the fits of each Support model and the No-Support model. The influence score for the revised lesson consists of the difference in the fit of the Revised-Support and No-Support models. The influence score for the commercial lesson consists of the difference in the fit of the Commercial-Support and No-Support models. Thus, in both cases, the influence scores reflect the influence that the lesson has on recall over and above that of the text. As before, the fit of the models, which is presented in Table 2, was evaluated in terms of the recall variance they accounted for, using the STEPIT procedure to estimate the p parameter.

The influence score of the revised lesson derived from these results is .189. In contrast, the influence score of the commercial lesson is .083. This result suggests that the revised lesson exerted a greater influence on comprehension than did the commercial lesson. The greater influence of the revised lesson on comprehension may thus be one reason why Beck et al. (1982) found that the revised lessons resulted in better comprehension than did the commercial lessons.

To assess the statistical reliability of these differences, biserial correlations between the actual and model predicted recall scores were computed for each subject, as described above. These data are summarized in Table 2. An analysis of variance with the lesson group (revised and commercial) as a between subject factor and presence of lesson reinstatements as a within subject factor was performed on the z-transformed correlation scores. The results of this analysis indicated that the Support models fit better than the No-Support models, $F(1,41) = 65.33$, $p < .01$, and that this effect interacted with lesson group, $F(1,41) = 5.92$, $p < .02$. A Newman-Keuls test indicated that the influence score of the revised lesson was greater than that of the commercial lesson, $p < .01$.

[1] Five subjects, three from the Commercial- and two from the Revised-Lesson groups, were omitted from all the analyses involving the biserial correlations. These subjects recalled less than 16 propositions. This low recall resulted in an extreme imbalance in the proportion of recalled and non-recalled propositions (6% versus 94%). When such extreme imbalances occur, the biserial correlation is inaccurate (McNemar, 1949).

Reasons for greater influence. The above results suggest that the revised lesson influenced comprehension more than did the commercial lesson. The question remains, however, as to why it did so. One explanation that can be immediately ruled out is the number of text propositions reinstated by the two lessons. The commercial lesson reinstated more text propositions (110) than did the revised lesson (98).

If the revised lesson didn't reinstate more of the text, why was it more influential? One reason may be that the propositions reinstated by the revised lesson were, on the average, reinstated 2.8 times. In contrast, propositions reinstated by the commercial lesson were, on the average, reinstated only 1.4 times. Thus, even though the revised lesson reinstated fewer text propositions, it resulted in more total lesson reinstatements (278 versus 152). Thus, if reinstatement frequency was a factor, it suggests that children in the RL group were better able to *establish* and link together the events comprising the plot of the story. The reason the commercial lesson resulted in fewer lesson reinstatements was that it attempted to do more than simply highlight the text by introducing such additional topics as library skills and art appreciation.[4]

Direct Versus Indirect Lesson Reinstatements

Because the revised lesson exerted a substantial influence on comprehension, it enables us to consider which aspects of that lesson were responsible for this influence. The first question to consider is whether direct and indirect lesson reinstatements of the revised lesson influence comprehension to an equal extent.

To study this issue, two influence scores were computed for the revised lesson. These influence scores consist of the difference in the fit of a model that incorporates all the lesson reinstatements and the fit of a model in which one type of lesson reinstatement has been omitted. The influence score for direct lesson reinstatements consists of the difference in the fit of a model incorporating all 278 lesson reinstatements (called All-Support) and a model in which the 247 direct reinstatements have been omitted (called No-Direct). The influence score for indirect lesson reinstatements consists of the difference in the fits of the All-Support model and a model in which the 31 indirect reinstatements have been omitted (called No-Indirect).

The fit, in terms of recall variance accounted for, of the No-Direct, No-Indirect, and All-Support models was determined by the STEPIT procedure described above to estimate the p parameter of a model. These

[4] This statement should not be construed as implying that library skills and art appreciation should not be taught. All that is implied is that having the child focus on such things during the course of comprehending a complex story may impair the children's comprehension of story events.

results are presented in Table 3. The influence score of direct reinstatements derived from these results is .156. In contrast the influence score of indirect reinstatements is −.001. These influence scores suggest that direct lesson reinstatements have an influence on comprehension over and above that exerted by indirect lesson reinstatements, while indirect lesson reinstatements apparently have little influence on comprehension over and above that of direct lesson reinstatements. This is an important, though hardly a surprising, finding. It suggests that, for the purposes of directing comprehension processes, little is gained by including global references to the story or asking about children's experience without making contact with the story.

To assess the statistical reliability of these influence scores, biserial correlations between the model-predicted and actual recall scores were computed for each subject. An analysis of variance with model type (No-Direct, No-Indirect, and All-Support) as a within subject factor was performed on the *z*-transformed scores. The results indicated that there was a reliable difference among the models, $F(2,42) = 34.61$, $p < .01$. The difference between the recall variance accounted for by the No-Direct and All-Support models comprising the influence score for direct lesson reinstatements was reliable, $p < .05$, Newman-Keuls test. The difference between the recall variance accounted for by the No-Indirect and All-Support models comprising the influence score for indirect lesson reinstatements was not reliable, $p > .05$, Newman-Keuls test.

Effects of Individual Lesson Components

Having localized the influential aspect of the revised lesson to that of direct reinstatements, we can further pinpoint the source of the influence of

TABLE 3
Relative Fit of No-Direct, No-Indirect, and All-Support Models

	Index of Fit		
Model	Recall Variance Accounted for	Biserial Correlation Between Predicted and Actual Recall	Value of *p* Parameter
No Direct	.259	.510	.060
No Indirect	.416	.627	.050
All Support	.415	.642	.050

these direct lesson reinstatements by considering the relative influence they exert within each of the four lesson components, Story Preparation, SRU Preparation, Pictures, and SRU Questions. To do this, four influence scores were computed. These influence scores consist of the difference in the fit of a model that incorporates all the direct lesson reinstatements and the fit of a model in which the direct lesson reinstatements from one lesson component have been eliminated. The influence score for the Story Preparation component consists of the difference in the fit of a model incorporating the 247 direct lesson reinstatements (called All-Direct) and a model in which the 102 direct Story Preparation reinstatements have been omitted (called No-Story). The influence score for the SRU Preparation component consists of the difference in the fits of the All-Direct model and a model in which the 26 direct SRU Preparation reinstatements have been omitted (called No-SRU). The influence score for the Picture component consists of the difference in the fits of the All-Direct model and a model in which the 37 direct Picture reinstatements have been omitted (called No-Picture). The influence score for the SRU Questions component consists of the difference in the fits of the All-Direct model and a model in which the 82 direct SRU Question reinstatements have been omitted (called No-Question). As before, the fit of the All-Direct, No-Story, No-SRU, No-Picture, and No-Question models was computed in terms of recall variance accounted for obtained by using the STEPIT procedure to estimate the

TABLE 4
Relative Fit of All-Direct, No Picture, No-SRU, No-Story, No Question Models

Model	Index of Fit		
	Recall Variance Accounted for	Biserial Correlation Between Predicted and Actual Recall	Value of p Parameter
All Direct	.416	.647	.050
No SRU	.400	.632	.051
No Question	.383	.621	.050
No Picture	.367	.608	.057
No Story	.352	.601	.053

p parameter for each model's equations. These results are presented in Table 4.

The influence scores for each component derived from these values are: for Picture, .016; SRU Preparation, .033; Story Preparation, .049; and SRU Questions, .064. These influence scores suggest that the SRU Questions and Story Preparation components exerted the most influence on comprehension while the Picture component exerted the least influence.

To assess the statistical reliability of these differences, biserial correlations between the model-predicted and actual recall scores were computed for each subject. These results are also presented in Table 4. An analysis of variance with model type (All-Direct, No-Picture, No-Story, No-SRU, and No-Question) as a within subject factor was performed on the z-transformed correlation scores. The results indicated that there was a reliable difference among the models, $F(4,84) = 8.56$, $p < .01$. Newman-Keuls tests showed that the influence scores of the SRU Preparation, Story Preparation, and SRU Question components were reliably greater than zero, $p < .05$, .01, and .01, respectively. The influence score of the Picture component was not reliably greater than *0*, $p > .05$. Moreover, the influence scores of the Story Preparation and SRU Questions components were both reliably greater than that of the Picture component, $p < .05$, and .01 respectively, Newman-Keuls test. Thus, of the four lesson components, the Story Preparation and SRU Questions components exerted the most influence.

DISCUSSION

The importance of the work reported in this paper lies in the fact that through the use of modeling, an account of how children comprehend a story presented as part of a directed reading lesson has been inferred. This hypothesized account of what children do *during* a lesson may give us more insight into how to design reading lessons than a simple description of what children do *after* the lesson.

One insight we have gleaned from the present processing description is that if a directed reading lesson focuses systematically on introducing relevant background knowledge and highlighting central content, it will exert a greater influence on how the children comprehend the story than if it does so only in a haphazard way. One likely reason our particular revised lesson was more effective in directing how children comprehended the story is that background knowledge was introduced, and the central parts of the story were reinstated, *repeatedly*, by different lesson components. The revised lesson was able to do this because it had no primary goals other than to reinstate, and to introduce background knowledge important to, central

story content. The commercial lesson was not so single-minded, and also attempted to expose children to notions such as art appreciation and library skills. The result was instruction with less focus and less effectiveness in directing how the children read.

Another insight we gained concerned identifying which aspects of the revised lesson were the most influential. First, we found that asking about, describing, or introducing general concepts exemplified by text events directly influenced comprehension more than references that were very general or involved the child's personal experiences without tying them to the story. Second, we found that the Story Preparation and SRU Questions were the most influential lesson components. In general, these two lesson components related the most directly to our lesson revision goals. The Story Preparation component naturally lent itself to introducing relevant background knowledge and the SRU Questions component naturally lent itself to prompting children to connect central story content (cf. Beck & McKeown, 1981). It may be for this reason that the influence of the revised lesson resides primarily in these two components.

The processing description provided in this paper is far from complete. Many important aspects of comprehension such as making causal connections, constructing a macrostructure, and coping with ambiguities, distant referents, missing causes and other structural complexities, have all been ignored. However, we are encouraged by how much we have learned from the simple models we used. Indeed, the insights gained from the extended Kintsch and van Dijk models used here suggest that constructing more elaborate models that can provide richer descriptions of comprehension is a promising direction for future research on comprehension instruction.

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APPENDIX A
Summary of Story Preparation Components of Commercial and Revised Lessons

Commercial Lesson	Revised Lesson
1. The child was asked if he or she knew what raccoons are like.	1. A picture of a raccoon was shown and the idea that raccoons appear as if they are wearing a mask was introduced. The child was asked about kinds of people who might wear masks, toward establishing that bandits wear masks.
2. The behavior of raccoons is discussed, including the facts that: a. Raccoons are small, furry animals that live in the woods. b. Raccoons are smart, curious animals who sometimes get into mischief. c. Raccoons are good at removing garbage can lids. d. Raccoons usually rinse their food in a stream or river.	2. The behavior of raccoons was discussed, including the fact that raccoons frequently live near people as a convenient food source, and that they hunt for food at night.
3. The child was told that he or she would get to know a raccoon through the story, and that the author wished to have the story read for enjoyment.	3. The concept of habit was introduced. Examples of habits that people have were presented, and the child was asked to contribute a habit of his or her own.
4. The child was told to look for some unusual things that happen to Mrs. McGinnis as a result of a raccoon.	4. The concept of habit was specifically linked to raccoons. Introduced here was the raccoon habit of picking up and carrying off objects that lie in his or her path.
	5. The concept of coincidence was introduced by a story example in which a stuck thermos lid was loosened by being accidentally knocked to the floor. Then a scenario was set up which the child was guided to complete by telling about a coincidence that could occur.
	6. The experimenter concluded by telling the child that Mrs. McGinnis, as well as the raccoon, exhibited some habits in the story, and that some coincidences occur.

APPENDIX B
SRU Preparation of Revised and Commercial Lessons

	Commercial Lesson	Revised Lesson
SRU 1		
	1. Look at the picture of the raccoon.	1. Look at the picture on this page.
	2. Is this the way a raccoon really looks?	2. In the picture you can see the raccoon and Mrs. McGinnis.
	3. Read the page to find out more about him.	3. Read the page to find out about the raccoon and Mrs. McGinnis.
SRU 2		
	4. Read this page to find out what kind of person Mrs. McGinnis is.	4. On this page you'll find out about some of the things Mrs. McGinnis always does—you know, her habits.
	5. The things that she does and says will give you an idea of the kind of person she is.	5. You'll also find out about something she did one night that was special.
SRU 3		
	6. Mrs. McGinnis has made her wish and gone to bed.	6. Mrs. McGinnis has made her wish and gone to bed.
	7. Look at the pictures.	7. Look at the picture across the bottom of the two pages.
	8. What do you think is going to happen?	8. Who is the raccoon looking at?
	9. Read these two pages to find out.	9. On these pages you can find out what the raccoon did and why the two men are there.
SRU 4		
	10. Can you tell from the pictures what is happening?	10. Look at the picture across the top of the two pages.
	11. Read to find out what the men try to do and what the little raccoon does as the men begin to carry out their plan.	11. What are the men doing?
		12. Read to find out what the men do and where the little raccoon goes after the men carry out their plan.
SRU 5		
	12. Do you think the artist enjoyed illustrating this story?	13. Look at the picture across the two pages.
	13. What do the pictures tell you?	14. As you read these pages you will find out why the men are running away and what the raccoon does after the men leave.
	14. Read these two pages to find out what the bandits do.	

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APPENDIX B *(Continued)*

Commercial Lesson	Revised Lesson
	15. You're going to read these two pages in just a minute—but first remember that just as you stopped reading before, the men were looking right at the little raccoon up in a tree.
SRU 6	
15. Do the pictures on these pages tell you how the story ends?	16. On these pages you'll find out what happens to the moneybag that the raccoon left.
16. Read to find out if the story has a happy ending.	

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APPENDIX C
Summary of Picture Content of Revised and Commercial Lessons

Commercial Lesson	Revised Lesson
SRU 1 and 2	
1. The raccoon is in an apple tree that is next to a house. Mrs. McGinnis is carrying pails of corn and a bundle of hay to a cow and two pigs who are looking expectantly at her.	1. The raccoon is sleeping in an apple tree that is next to a house. Mrs. McGinnis is standing in the doorway of the house. It is night, and Mrs. McGinnis is on her doorstep looking up at the sky.
SRU 3	
2. The raccoon is hiding behind a tree, looking at two men who are next to their horses.	3. The raccoon is hiding behind a tree, looking at two men who are next to their horses.
SRU 4	
3. The two men have tied up the cow and two pigs and are carrying them away from Mrs. McGinnis' house. The raccoon is following.	4. The two men are leading the cow and two pigs down a road. The raccoon is following.
SRU 5	
4. The raccoon is in a tree. The cow and pigs are underneath the tree, still tied up. The men look scared and are running away from the raccoon.	5. The raccoon is in a tree. The men look scared and are running away from the raccoon.
SRU 6	
5. There is a barn with the cow and pigs looking out. Mrs. McGinnis is jumping in front of the barn. The barn is next to Mrs. McGinnis' house. The raccoon is in the apple tree that is next to Mrs. McGinnis' house. There is a slice of bread on the doorstep of the house.	6. There is a barn. The barn is next to Mrs. McGinnis' house. It is night and Mrs. McGinnis is leaning against the apple tree that is next to her house, looking at the barn.

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APPENDIX D
SRU Questions of Revised and Commercial Lessons

	Commercial Lesson	Revised Lesson
SRU 1		
	1. Do you think a raccoon can be tamed?	1. Who lived in the apple tree?
	2. Where did the raccoon in the story live?	2. What does it look like the raccoon has around his eyes?
	3. What did you find out about the raccoon that you couldn't tell by just looking at the picture?	3. Who lived in the house that was next to the raccoon's tree?
	4. How could you tell that the raccoon lived near Mrs. McGinnis?	4. What did Mrs. McGinnis do when she saw the star?
SRU 2		5. What did she wish for?
	5. How did Mrs. McGinnis care for her animals and the raccoon?	6. What did Mrs. McGinnis put on her step for the raccoon?
	6. Have you ever wished upon a star?	7. Did the raccoon know the bread was for him?
	7. What kind of wish did Mrs. McGinnis make?	
	8. From the kind of wish she made, what do you know about Mrs. McGinnis?	
SRU 3		
	9. Did Mrs. McGinnis get her wish?	8. Why did the raccoon come down from the tree?
	10. What did the raccoon do?	9. After the raccoon ate the bread, why did he look for more food?
	11. Why did the raccoon swish his bread in the water?	10. What did the raccoon do when he saw the men coming?
	12. Where can we find out?	11. Where were the men going
	13. Why were the two men going to Mrs. McGinnis' house?	12. Why were the men going to Mrs. McGinnis' house?
	14. Do you suppose they were right about Mrs. McGinnis not finding out that her animals were gone?	
SRU 4		
	15. Why do you suppose the men wore masks?	13. Why did the men go to Mrs. McGinnis house?

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APPENDIX D *(Continued)*

Commercial Lesson	Revised Lesson
16. Why did the raccoon follow them?	14. What did the men put over their faces?
17. Were the robbers calm and sure about stealing the cow and pigs? How could you tell?	15. Where were the men walking after they left with the cow and pigs?
18. What made the men think someone was following them?	16. Because the men kept hearing noises, what did they think was happening?
19. Why did the raccoon climb a tree?	17. Who did the men see in the tree?
20. What did he do when he got there?	18. What part of the raccoon could they see?
21. How do you think the men felt when they looked at the little raccoon?	
SRU 5	
22. Who did the bandits think the raccoon was?	19. Who did the men think they saw in the tree?
23. Why do you think the raccoon swished the moneybag in the water?	20. What did the men do when they thought they saw a bandit?
24. Did he purposely leave the moneybag for Mrs. McGinnis?	21. What did one of the men toss on the ground?
25. Would a raccoon know or care about a moneybag?	22. What was the raccoon looking for when he went back to Mrs. McGinnis' doorstep?
	23. What did the raccoon do with the moneybag when he didn't find anything on the steps?
SRU 6	
26. When did Mrs. McGinnis find the moneybag?	24. What had been left on the doorstep that Mrs. McGinnis found in the morning?
27. What does she immediately plan to do with the money?	25. Who left the moneybag on the doorstep?
28. What does Mrs. McGinnis think is responsible for her good luck?	26. How did Mrs. McGinnis think the moneybag got there?
	27. At the beginning of the story, what did Mrs. McGinnis wish for?
	28. What did Mrs. McGinnis do with the money to make the wish come true?